



INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior
National Park Service

All or some of the information you provide may become available to the public.

OMB # (1024-0236)
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Reporting Year: 2008	Park: Shenandoah NP	Select the type of permit this report addresses: Scientific Study	
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Project Title (maximum 300 characters): The Next Generation: Deer Browsing on the Growth, Survival, and Demography of Tree Seedlings in the Shenandoah National Park			
Park-assigned Study or Activity #: SHEN-00347	Park-assigned Permit #: SHEN-2008-SCI-0004	Permit Start Date: Mar 10, 2008	Permit Expiration Date: Dec 31, 2008
Scientific Study Starting Date: Mar 10, 2008		Estimated Scientific Study Ending Date: Jul 31, 2009	
For either a Scientific Study or a Science Education Activity, the status is: Continuing		For a Scientific Study that is completed, please check each of the following that applies: <input type="checkbox"/> A final report has been provided to the park or will be provided to the park within the next two years <input type="checkbox"/> Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park <input type="checkbox"/> All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed	
Activity Type: Research			
Subject/Discipline: Plant Communities (Vegetation)			

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

Populations of white-tailed deer have substantially increased in the eastern United States over the last 100 years and are currently at record high levels in some areas. Increased browsing pressure by growing deer populations on tree seedlings can affect seedling growth, survival and ultimately forest succession and the composition of the future forest community. It is important to understand changes in forest succession given that many tree species are becoming locally extinct and may experience further changes due to introduced forest pathogens and changing climate regimes. This study uses three 200 x 200 m deer exclosures, which have been in place for approximately 14 years, to examine the effects deer herbivory on the growth, survival and demography of northern red oak (*Quercus rubra*) tree seedlings growing in the forests of the Shenandoah National Park.

Our objectives in this study were to test two hypotheses. First, we expected release from white-tailed deer herbivory would result in the increased survival, but slower growth rate of northern red oak seedlings. Second, given the increased densities of tree seedlings and other herbaceous plants that have resulted from 14 years of white-tailed deer exclusion, we hypothesized that fewer resources would be available to mature trees which would result in decreased growth rates relative to those in areas exposed to deer. Thus white-tailed deer affect the current and future tree communities of forests by directly influencing the survival, growth, and mortality of tree seedlings, but also by indirectly affecting the growth rates of adult trees in a forest community.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

Our findings support both of our hypotheses. Herbivory by white-tailed deer can have large effects on seedling populations and potentially on the structure and composition of red oak communities and eastern deciduous forests in general. This is important because many different species within the forest ecosystem, including chipmunks, birds, and even soil fungi, depend on acorn crops or other ecological services provided by oak trees. Any effects on oak trees that result in changes in the acorn crop or the other ecological services they provide may have repercussions on the other species that depend on oak trees.

Specifically, we found densities of northern red oak seedlings were significantly greater inside deer exclosures than outside exclosures which were exposed to ambient levels of deer browsing. Survival of northern red oak seedlings were 24% higher inside deer exclosures than outside exclosures. Likewise, seedling heights were significantly greater inside the exclosures. The growth rate of seedlings tended to be slower inside the exclosures, but this difference was not statistically significant. We measured acorn production inside and outside the exclosures, but there were no significant differences when acorn production is standardized per m2 of trunk basal area. Our data suggest growth rates of adult trees (i.e. trees with a diameter at breast height > 10 cm) may be influenced by white-tailed deer herbivory. Growth rates of adult trees inside two exclosures were greater than growth rates outside of the exclosures. There were no differences at the third site, suggesting an important interaction exists between growth rates of adult trees and sites. This may be caused by differences in the deer population at the three sites, differing nutrient availability at the sites, or some other unstudied biotic or abiotic factor.

Conclusion: White-tailed deer herbivory affects the growth and survival of northern red oak seedlings and may also affect the growth rate of adult trees. Such impacts by white-tailed deer will ultimately influence the composition, structure, and dynamics of the current population of northern red oak trees and forest ecosystems in the future.

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

Yes

If "Yes", identify where the specimens currently are stored:

In my lab at the University of Wyoming

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):

\$0

Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):

\$1500

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

Paperwork Reduction Act Statement: A federal agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. Public reporting for this collection of information is estimated to average 1.625 hours per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms. Direct comments regarding this burden estimate or any aspect of this form to Dr. John G. Dennis, Natural Resources (3127 MIB), National Park Service, 1849 C Street, N.W., Washington, DC 20240.